



March 1, 2000

**DESIGN MEMORANDUM No. 00-03**  
**POLICY CHANGE**

**TO:** All Design, Operations, and District Personnel, and Consultants

**FROM:** \s\ Richard L. VanCleave  
Richard L. VanCleave  
Design Policy Engineer  
Technical Services Division

**SUBJECT:** Impact Attenuator Design and Contract Document Preparation Requirements

**SUPERSEDES:** Design Memorandum No. 99-09 dated April 26, 1999, and All Impact Attenuator References In Design Manual Chapter 49

**EFFECTIVE:** September 12, 2000, Letting

The policy relating to impact attenuators has been changed to adhere to the current AASHTO and FHWA accepted Test Levels (TL-2 and TL-3).

1. The format for impact attenuator pay items is "Impact Attenuator, (Type), (Width), (Test Level)".
2. There are four impact attenuator types. They are ED, R1, R2, and CR.
3. There are three impact attenuator widths. They are W1, W2, and W3.
4. Impact attenuator design will be limited to Test Level-2 (TL-2) and Test Level-3 (TL-3).

Based on the above, "**Impact Attenuator, R1, W1, TL-3**" is an example of an impact attenuator pay item.

All contract document references to impact attenuators must be in the pay item format noted above.

Attached is an interim design procedure to replace Section 6.0 of Chapter 49 of the Design Manual. This interim procedure will remain in effect until superseded by an official Design Manual revision or another Design Memo/Policy Change document. In addition, Design Memorandum No. 00-03 Technical Advisory has been prepared to provide additional information regarding the design and contract document preparation procedures related to impact attenuators.

References to impact attenuators in other sections of the Design Manual are also superseded by this document. Designers are instructed to follow the attached interim procedure to verify impact attenuator warrants.

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## **INTERIM DESIGN MANUAL CHANGES**

### **49-6.0 IMPACT ATTENUATORS**

#### **49-6.01 Types of Impact Attenuators**

The Department uses four types of impact attenuators. They are as follows:

1.           Type ED.     Type ED impact attenuators are energy dissipation devices.
2.           Type R1.     Type R1 impact attenuators are energy dissipation devices that have redirective capability on one side.
3.           Type R2.     Type R2 impact attenuators are energy dissipation devices that have redirective capability on two sides.
4.           Type CR.     Type CR impact attenuators are also energy dissipation devices that have redirective capability on two sides. These attenuators are used at locations where there are lateral clearance restrictions that make installation and maintenance of the attenuator difficult.

#### **49-6.02 Design**

After the design of roadside barriers is performed in accordance with Section 49-5.0, it is necessary to determine whether there are any obstructions located within the clear zone that are not protected. Obstructions that can be protected by extending a proposed barrier a short distance should be protected in that manner. However, impact attenuators should be utilized to protect isolated obstructions.

Figure 49-6A illustrates common impact attenuator installations. The D1 dimension shown on the figure determines whether an attenuator is warranted and, if so, whether the attenuator requires redirective capability on the side adjacent to traffic under consideration. The D2 dimension shown on the figure is used to determine whether the attenuator requires redirective capability on its backside.

For obstructions in gore or similar areas, the offset dimension from the edge of the obstruction face to the mainline outside pavement edge must be compared to the similar measurement between the obstruction and the ramp inside pavement edge. The smaller of the two offsets is defined to be D1 and the larger offset is considered to be D2.

The attenuator type is determined using Figure 49-6B. The attenuator selection design is based on the appropriate test level for the project design speed of the roadway under consideration. If the design speed is 70 km/h or less, the attenuator design must be in accordance with Test Level 2 (TL-2) criteria. All other higher project design speeds require an attenuator design which is in accordance with Test Level 3 (TL-3) requirements. Attenuators shielding obstructions located between roadway facilities with different design speeds (e.g. in gore areas) must be in accordance with the Test Level requirement for the higher design speed.

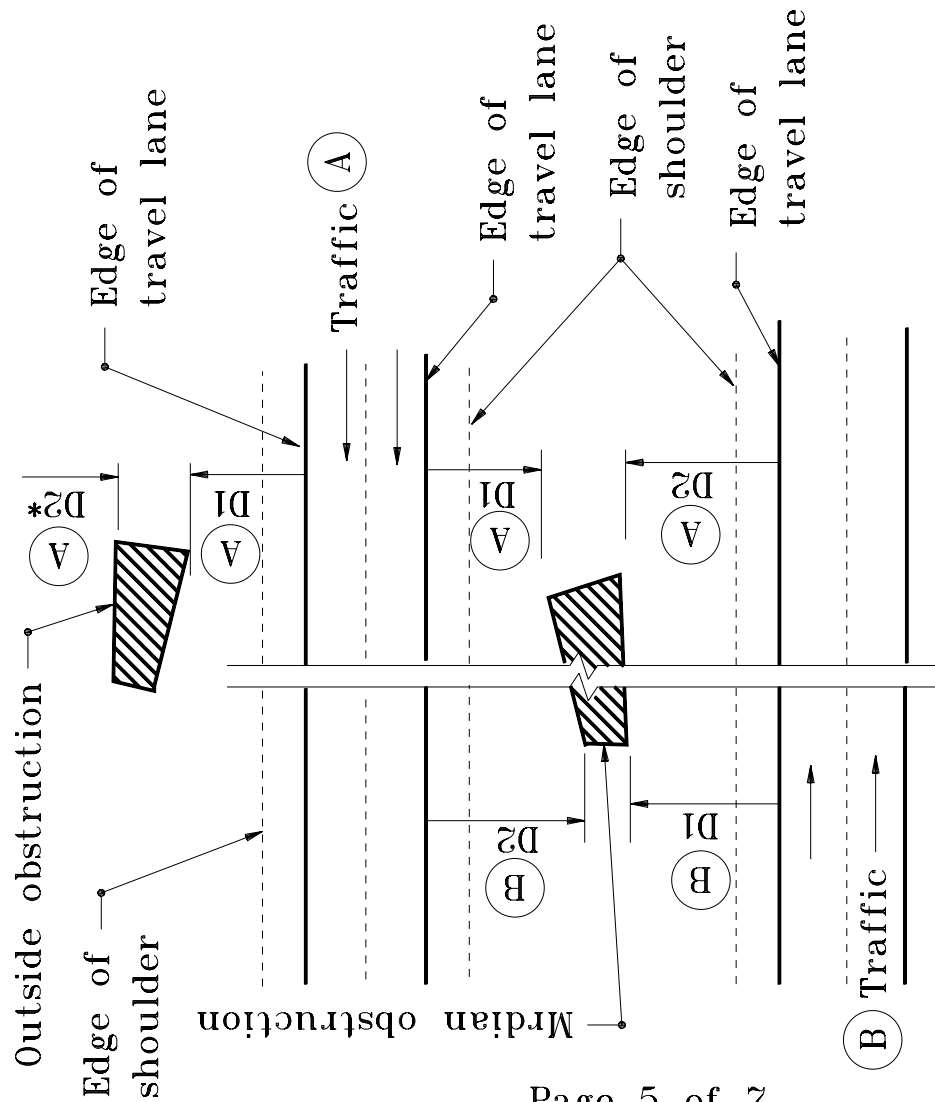
The required attenuator width designation is based on the width of the obstruction. There are three standard widths available and they are as follows:

1. W1. This attenuator width is required for obstructions that are no more than 900 mm wide.
2. W2. This attenuator width is required for obstructions that are more than 900 mm wide but less than or equal to 1800 mm in width.
3. W3. This attenuator width is required for obstructions that are more than 1800 mm wide but less than or equal to 2400 mm in width.

Type ED impact attenuators are only available in the W1 width. If Figure 49-6B indicates that a type ED attenuator is required and the obstruction width is greater than 900 mm, an investigation regarding the feasibility of moving the obstruction to another location where shielding is not necessary, or altering the obstruction to a width less than or equal to 900 mm must be performed. If moving or altering the obstruction is not feasible, the minimum appropriate method for protecting the obstruction is to install two guardrail transition type GP units at a maximum 30:1 flare rate with respect to the roadway center line—one end of the guardrail transition pair is attached to the obstruction and the other end of the pair is attached to a type MS guardrail end treatment. Depending on the width of the obstruction, it may be necessary to supplement the above noted minimum treatment with w-beam guardrail in order to maintain the 30:1 maximum flare rate. Details of this special obstruction protection method must be developed by the designer and shown on the plans.

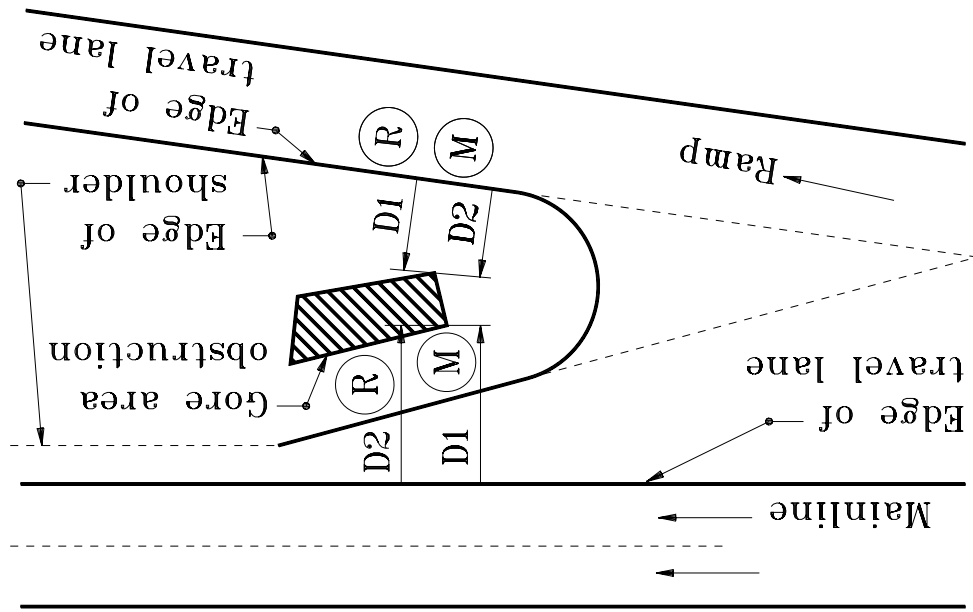
For all other impact attenuator types, if the obstruction width is greater than 2400 mm, the obstruction should be shielded by a special attenuator design, altered so the width is less than or equal to 2400 mm, or moved to a location where shielding is not required.

Figure 49-6C illustrates the space requirements for approved impact attenuators. On roadways with a shoulder section, the attenuator footprint shown on the figure must not encroach onto the usable shoulder, as defined in Chapters 53, 54, and 55 of the Design Manual, as appropriate. On roadways with curbs, the attenuator footprint must not encroach onto the 0.5 m appurtenance-free zone, as discussed in Section 49-2.0. If the roadway section features a sidewalk, the attenuator footprint must not encroach upon the sidewalk so that the remaining sidewalk width is less than 1.0 m. If the attenuator footprint violates any of the above encroachment limits, the obstruction should be shielded with a roadside barrier, altered so the footprint encroachment is satisfactory or should be moved to a location where shielding is not required.



\* For an outside obstruction with no pavement located to the outside of the obstruction,  $D2$  is defined to be greater than 15 m.

## MULTI-LANE DIVIDED FACILITY OFFSETS



Use smaller of  $D1$  values

$M$  Mainline

$R$  Ramp

## GORE AREA OFFSETS

## IMPACT ATTENUATOR OFFSET EXAMPLES

<b>Attenuator Type</b>	<b>Test Level 3 (TL-3)</b>	<b>Test Level 2 (TL-2)</b>
	<b>Offset Dimensions D1 &amp; D2, (If Applicable)</b>	<b>Offset Dimensions D1 &amp; D2, (If Applicable)</b>
<b>ED</b>	$7.6 \text{ m} \leq D1 \leq 15 \text{ m}$ $7.6 \text{ m} \leq D2 \leq 15 \text{ m}$	$D1 = 7.6 \text{ m}$ $D2 = 7.6 \text{ m}$
<b>R1</b>	$3.0 \text{ m} < D1 \leq 15 \text{ m}$ $D2 > 15 \text{ m}$	$3.0 \text{ m} < D1 \leq 7.6 \text{ m}$ $D2 > 7.6 \text{ m}$
<b>R2</b>	$3.0 \text{ m} < D1 < 7.6 \text{ m}$ $D2 \leq 15 \text{ m}$	$3.0 \text{ m} < D1 < 7.6 \text{ m}$ $D2 \leq 7.6 \text{ m}$
<b>CR</b>	$D1 \leq 3.0 \text{ m}$	$D1 \leq 3.0 \text{ m}$
<b>None Required</b>	$D1 > 15 \text{ m}$	$D1 > 7.6 \text{ m}$

Refer To Section 49-6.02 & Figure 49-6A For Additional Information Regarding D1 & D2

**D1**—Offset Dimension From Edge Of Obstruction Face To Edge Of Travel Lane In The Direction Of Travel Under Consideration

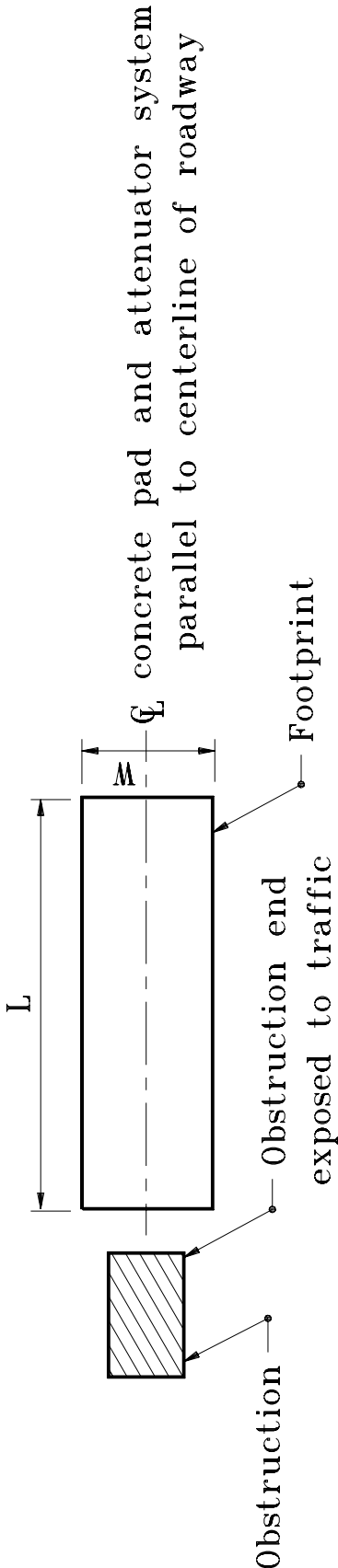
**D2**—Offset Dimension From Edge Of Obstruction Face To Edge Of Travel Lane On Opposite Side Of The Obstruction, If Applicable

## **IMPACT ATTENUATOR TYPE DETERMINATION**

**Figure 49-6B**

NOTES:

1. The table shows approximate footprint of required space including pad for impact attenuator system.
2. Non-mountable curbs should not be used in front of impact attenuator.



(Type of attenuator)/ Width designation	Required impact attenuator system space, in m	
	Footprint: Length (L) x (W)	Test Level-2 (TL-2)
(ED)/W1	14.5 x 6.1	9.0 x 5.6
(R1,R2,CR)/W1	12.5 x 1.35	6.5 x 1.35
(R1,R2,CR)/W2	12.5 x 2.6	6.5 x 2.6
(R1,R2,CR)/W3	12.5 x 3.1	6.5 x 3.1

IMPACT ATTENUATOR FOOTPRINT REQUIREMENTS

Figure 49-6C